Environment Canada
Environnement Canada

CANADA'S ENVIRONMENT

AN OVERVIEW

Canada

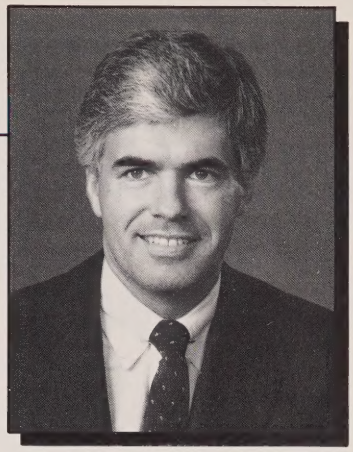
1986

CONTENTS

Catalogue No. EN 21-54/1986-1E
ISBN 0-662-14571-2

Aussi disponible en français

MINISTER'S MESSAGE



In the last two decades, Canadians have become aware, as never before, of the importance of the environment to their own well-being and economic health. But what, exactly, is the state of our environment?

Until recently, this question has been almost impossible to answer. Although there has been an ever-increasing flow of information, it has been fragmented and, therefore, of limited helpfulness.

The **State of the Environment Report for Canada**, prepared by Environment Canada and Statistics Canada, pulls together pieces of information so that patterns of change can be more easily identified and understood. It sets out, as factually as possible, the condition of the farmlands, forests, water, wildlife and the other resources that, as Canadians, we hold in common, and it identifies the major factors that will change those conditions, whether for better or worse. In effect, the publication constitutes the first "state of the environment" assessment ever attempted in Canada.

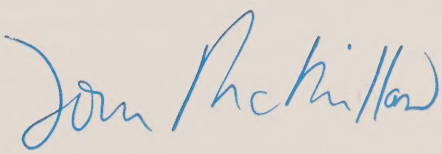
To make this assessment more accessible to Canadians, Environment Canada has produced **Canada's Environment: An Overview.** It summarizes salient points from the original technical publication, in a more readable form.

This overview of the Canadian environment challenges all of us. I am very proud, at this point in history, to work with Canadians to protect the environment, not only for ourselves, but for future generations.

Serious problems, such as acid rain and the proliferation of toxic chemicals in our environment, must be remedied. There is a definite need to manage our activities so that our water resources and our wildlife are not jeopardized. The natural and built heritage that we hold in trust must also be safeguarded.

Governments have a responsibility to make use of the legislative tools at their disposal to carry out this task. Each one of us, whether in government, industry, labour or in the voluntary sector, must also take whatever steps are necessary to resolve urgent environmental issues.

If the environment is to be protected in the manner and to the degree that Canadians have said — time and again — that they want it protected, then they must have an accurate picture of what has happened, is happening and is likely to happen to their air, soil and water. I therefore urge you to read this document carefully.



May 1986

CANADIANS AND THEIR ENVIRONMENT

THE STATE OF THE ENVIRONMENT

The environment keeps us alive. It provides the oxygen we breathe, the water we drink, the food we eat, and the resources we need. We are part of the environment, affected by it every moment of every day.

In short, we rely on the environment for life itself. This fundamental truth is ample reason for concern about environmental quality — but it does not tell the full story. Consider, for instance, how the quality of our lives is influenced by the health of the environment. If wastes make our cities less agreeable places to live; if we degrade or destroy the lakes, rivers and woodlands where we spend so much of our leisure time; if we fail to protect wildlife habitat; if we neglect our natural and historic heritage; if we do any of these things, we become poorer — not richer.

Moreover, a strong economy depends upon a healthy environment. If we allow pollution slowly to destroy forests and fisheries; if we use our land and harvest its produce in ways that are not sustainable; if we open every piece of land to human activities; if we do any of these things, we again become poorer — not richer.

Canadians recognize the importance of the environment. Our growing interest is illustrated by the fact that, despite all the other pressing national and international problems, environmental issues now take up more space than ever before in Canadian newspapers. Unfortunately, the information received by the public is often incomplete or contradictory. It's hard to see how all the issues and concerns fit together — what's important and what's not, what's changing and what's not. In short, most people find it difficult to answer the question: WHAT IS THE STATE OF OUR ENVIRONMENT?

The **State of the Environment Report for Canada** begins to answer the question. This booklet offers a selection of some of the salient points. It is intended to help Canadians understand more about their environment — and to help them understand how we are doing in our efforts to maintain the quality of the environment that we will be passing on to our children and their children.

UNDERSTANDING THE CONCEPTS

To understand the information presented in this booklet, we need to define three terms that are used throughout: ecosystem, ecozone and stress-response.

ECOSYSTEM

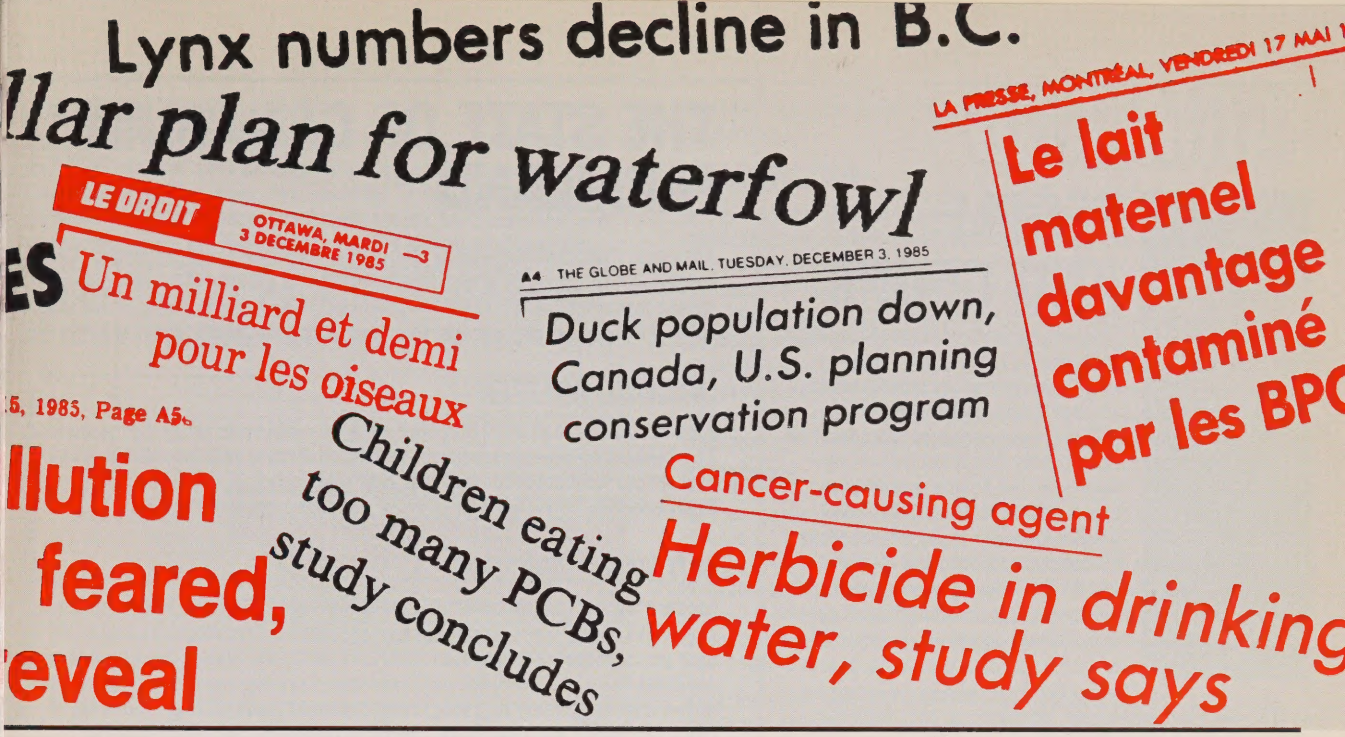
The term **ecosystem** is short for ecological system. It refers to living and non-living elements functioning as a unit in nature. An ecosystem can be large or small; whatever its size, it includes all the plants, animals and microorganisms within the system, together with the physical environment with which the organisms interact.

We can speak broadly of forest ecosystems or marine ecosystems, or more specifically of spruce-aspen-birch ecosystems or near-shore ecosystems. A woodlot can be considered an ecosystem, as can a small pond. Because of the interactions among the different parts of an ecosystem, significant changes to one part will affect the other parts. When we assess the impact of human activities on the environment, this interdependence must be considered.

ECOZONE

Canada is an immense country, and it exhibits ecological diversity to match its size. It includes flat plains and high mountains, dense forests and near-deserts, mild climates and the arctic extremes, highly urbanized regions and vast uninhabited areas. To provide a framework for describing trends and conditions in such a variety of environments, the country has been divided into 15 **ecozones** — each one made up of land areas with broadly similar environmental characteristics. The 15 ecozones are shown on the inside back cover, which can be folded out for ease of reference while reading this booklet.

Ecozones are distinguished from one another by differences in landforms, water, soils, vegetation, climate, wildlife and — to some degree — the human activities that have occurred in the region. Because they are based mainly on natural diversity, ecozones cut across political boundaries. Only Nova Scotia and Prince Edward Island lie entirely within one



ecozone, and several provinces include portions of five or six ecozones. The largest ecozone (the Boreal Shield) is ten times larger than the smallest (the Atlantic Maritime), and 53 per cent of all Canadians reside in the second smallest (the Mixed-Wood Plain). The two tables facing the map describe the ecozones in more detail.

STRESS AND RESPONSE

The concept of **stress-response** allows us to focus on the connections between human activities and the resulting changes in the environment. Sewage loading to a river, for example, creates a stress, and contaminated fish are one response. Converting woodland to agriculture creates a stress, and fewer bears in the area is a response. The chain can continue; for instance, the contaminated fish may become a stress on those who eat them, with illness being the likely response.

However, the complexity of the stress-response relationship, and our still limited knowledge of the environment, prevent us from fully understanding the path from cause to effect. Even so, we know that ecosystems are always subject to stress. Human beings are responsible for some stresses: we harvest renewable resources, exploit non-renewable ones, alter land uses and generate and dispose of wastes. Nature generates stresses through changes in climate, geological events, animal migrations and disease. Human activities can influence the responses to natural stresses, sometimes reducing but more often magnifying their effects.

By itself, the fact that an ecosystem is under stress is not necessarily of concern. Within limits, ecosystems can adapt to stress; indeed, some degree of stress may promote environmental health. Disease, for example, can eliminate the weaker animals in some wildlife herds (to the benefit of the herd as a whole).

This does not argue for complacency. On the contrary, the stress-response concept tells us that we must be concerned about situations where the character of the response indicates that an ecosystem is no longer capable of coping with a stress. In such cases, we may need to develop our own response — we must control and manage the human activities that are the source of the problem.

ENVIRONMENTAL REPORTING

This booklet presents a great deal of information that can help us understand how we are doing in our efforts to maintain the quality of Canada's environment.

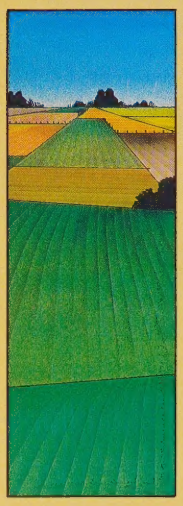
The core of environmental reporting lies in interpreting and analyzing data. The preparation of the **State of the Environment Report for Canada** has revealed that many of the data we need are not available in any form, while the remainder vary widely in quality. The information used to prepare the State of the Environment Report is the best we currently have available. Over time, the quality of information available will improve, so that future reports will benefit from our growing ability to gather and interpret relevant data. Statistics Canada's environmental publication entitled **Human Activity and the Environment: A Statistical Compendium** is a major contribution to the field of environmental reporting in Canada.

WHERE DO WE GO FROM HERE?

In the near future, Environment Canada will be seeking comments and views to determine how subsequent State of the Environment reports should be developed to better meet the needs of Canadians. If you wish to provide us with your views, please write to:

State of the Environment Report
Corporate Planning Group
Environment Canada
Ottawa, Ontario
K1A 0H3

FARMLAND



PEOPLE AND CROPS

Only about five per cent of Canada's land area is capable of being cultivated. About an equal amount of land is in woodlots, native pasture, range lands or sloughs. Our high-quality farmland is located mostly in the Prairie and Mixed-Wood Plain ecozones, with much smaller amounts in the Boreal Plain, Montane Cordillera and Atlantic and Pacific Maritime ecozones. Despite this limited land base, farm cash receipts in 1985 were $20 billion and exports for the same year are estimated at $9 billion. Agriculture, as Canada's second largest industry, directly provides half a million jobs.

DIFFERENT ECOZONES/ DIFFERENT FARMS

The productivity of our farmland depends on climate, type of soil and soil nutrients, the availability of water and the management practices of Canada's 300 000 or more farmers. Differences in natural conditions mean that agricultural practices (and their associated stresses) vary across the country. Farms in the Prairie ecozone are on average five or six times as large as those elsewhere in Canada. Prairie farms grow mostly close-row crops such as wheat, oats, barley, flaxseed, canola and rye. The majority of farms in the Mixed-Wood Plain of Ontario and Quebec grow wide-row crops like corn, soybeans, sunflowers, field beans and other vegetables, and forage crops like alfalfa. Farms in the Atlantic and Pacific Maritime ecozones are devoted primarily to forage crops and grazing, but, along with the Mixed-Wood Plain and Montane Cordillera ecozones, they also specialize in fruit and vegetable crops.

SOILS AT WORK

Organic matter and nutrient content are two key components of soil productivity. In an uncultivated soil, most residues from decaying plants are returned to the soil. Microorganisms and weathering convert this material into new humus in the upper active soil layer. This humus contributes to the soil's ability to hold water, resist erosion, provide favourable rooting conditions and deliver nutrients in a form plants can use.

When crops are harvested, the quantity of plant residue and nutrients returned to the soil is reduced, and the consumption of existing organic matter may be accelerated. To sustain soils under cropping, organic matter must therefore be added to the soil and additional nutrients made available. This can be accomplished by adding manure or chemical fertilizers and by growing nitrogen-fixing crops.

THE STATE OF CANADIAN FARMLAND

Although Canadian farmlands continue to produce excellent yields, there are increasing concerns about deteriorating soil quality. Also of concern are the loss of prime farmland to urbanization and the draining of wetlands, both of which are discussed in the chapter called Land Use.

ORGANIC MATTER

Loss of organic matter is becoming a major problem in many farming areas. The content of organic matter in cultivated Prairie soils has declined by over 40 per cent since the soil was first tilled, and, in the Mixed-Wood Plain ecozone, reductions of over 50 per cent have been found.

NUTRIENT CONTENT

Modern agriculture requires increasing amounts of fertilizer to produce high-yield crops. For Canada as a whole, sales of fertilizers increased by nine per cent annually between 1970 and 1977; the highest increases in area fertilized were in the Prairie and Montane Cordillera ecozones. Research shows that as recently as 1960, crops obtained more of their nutrients from the native soil than from chemical fertilizers. By 1980, however, the situation had been reversed in all provinces except Saskatchewan and Alberta. This implies both that soil nutrient content has declined and that the new genetic varieties of crops demand more from the soil.

MAJOR STRESSES ON OUR FARMLAND

CULTIVATION PRACTICES

Technologically advanced cultivation practices, together with the availability of better quality seed and hardier varieties, have led to improved crop yields in Canada over the past 30 years. However, some cultivation practices have negative side effects. Wide-row planting of single crops leads to increased erosion from wind and run-off. Continued planting of the same crop without rotation accelerates the decline of organic matter and soil nutrients. About 75 per cent of all Prairie crops are grown without another crop in the rotation. In Ontario and Quebec, this figure is one-fifth, but the fraction has almost doubled since 1975. Planting one crop variety over large areas makes it more susceptible to damage from weeds, pests and disease, which in turn requires the increased use of pesticides.

PESTICIDE USE

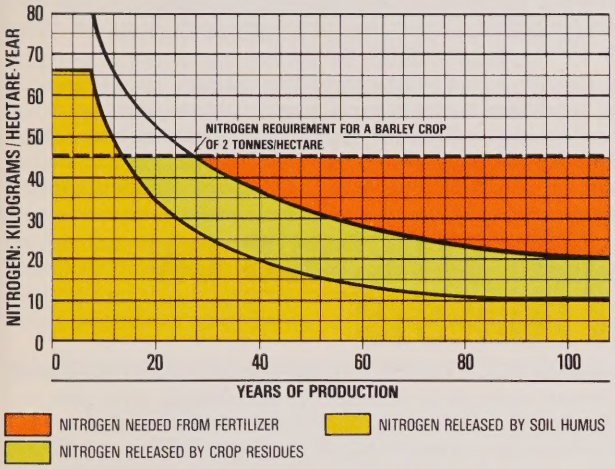
Areas treated with pesticides increased by 300 per cent on average during the 1970s, but they increased by over 500 per cent in the Boreal Plain and Boreal Shield ecozones. Unfortunately, many plants and organisms important to the functioning of ecosystems can be destroyed along with the pests. For example, the pests' natural enemies are often destroyed, leaving the farmer even more dependent on pesticides. Moreover, only a little of the pesticide actually reaches the target pests. The rest is dispersed in soil and water or absorbed into vegetation, where it may pose a risk to wildlife and to people before it degrades.

Some farmers are now adopting integrated pest management, a strategy that combines biological with chemical control agents and employs other tactics, such as early-warning monitors, to show when a pest problem is

ACIDIFICATION

The natural process of acidification of surface soils by leaching and crop removal may be accelerated by acid rain and by the use of nitrogen fertilizers. For example, in much of eastern Canada, measurable increases in soil acidity have occurred and some researchers attribute 40 per cent of this to acid precipitation and 60 per cent to the use of nitrogenous fertilizer. Excessive soil acidity reduces crop yields and releases trace elements that are toxic and may become concentrated in plants or in run-off to streams.

NITROGEN REQUIREMENTS FOR BARLEY IN THE PRAIRIES



SOURCE: Canadian Environmental Advisory Council, Report No. 15.

SALINIZATION

Many soils are naturally somewhat saline or "salty", but the application of water to cultivated land promotes the leaching of salts to the surface from subsurface layers. This, in turn, upsets the nutrient balance in the surface soil and reduces growth. The build-up of salts is a problem in the Prairie ecozone, where estimates place the annual increase in salinity at 10 per cent in some areas, with one hectare in 10 affected. Another 100 000 hectares in Alberta and Saskatchewan suffer from salinity because of excessive irrigation. Severe salt build-up in soils can be reversed only with great difficulty and expense.

EROSION

The economic value of soil lost through erosion in Canada is estimated to be $1.2 billion per year. The rate of soil loss from farmland by run-off or wind erosion depends on the vegetation or crop cover, the amount of organic matter in the soil, tillage practices and the topography of the land. Erosion by run-off is a particular problem in areas where wide-row crops like corn and potatoes are grown.

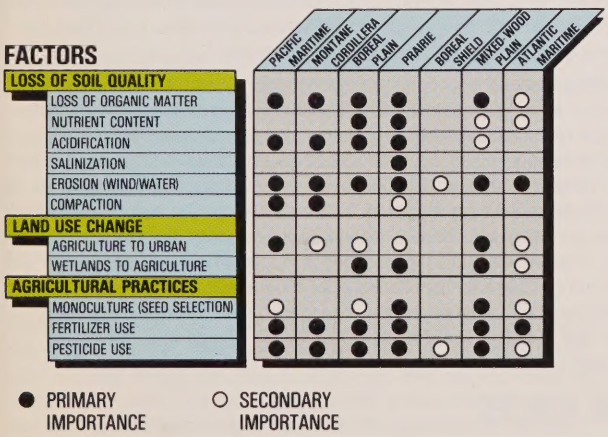
Rotating corn with hay and oats can reduce annual losses to one tonne per hectare. In the Prairie provinces, 40-fold reductions in erosion losses have been achieved by using five-year rotations of wheat, oats, barley and hay instead of a wheat-fallow rotation. Areas where there is a high risk of wind erosion include the sandy soils under continuous cultivation in Prince Edward Island and Ontario, and in the Prairies where summer fallowing is practiced.

imminent. Such techniques could reduce pesticide use substantially. For instance, questions are being raised about the large amounts of pesticides applied to fruit for cosmetic reasons; integrated pest management can provide an alternative.

LOSS OF GENETIC STOCK

Growing concern is being expressed about our seed selection practices. The focus on a few commercial strains has led to the loss of many native varieties worldwide. We now depend upon a narrower genetic base that is more vulnerable to stress. Protecting genetic stocks by establishing seed banks is a form of insurance against losses brought about by climate change and disease.

MAJOR INFLUENCES ON CANADIAN FARMLAND



SOURCE: State of the Environment Report for Canada, 1986.

ECONOMIC FACTORS

Market forces create considerable, if indirect, stresses on farmland. Changing land values, commodity prices, the cost of machinery and materials, and interest rates, along with changing social values and market demands, must all be considered by the individual farmer. Some of these conditions vary widely from place to place. A hectare of prime farm land, for example, may be 10 times more expensive if it's near a city than if it's part of a more distant farm. In some cases, the effort to maintain short-term profitability can inadvertently threaten the long-term stability of the farm operation.

OUTLOOK

The maintenance of farmland in Canada is essential for our economy and for the provision of high-quality food for future generations. The keys to sustainable agriculture lie in tailoring the cultivation practices to specific climatic and soil conditions. Today, economic pressures can force farmers to increase production at the expense of the long-term sustainability of the agricultural ecosystem. Moreover, agricultural activities cannot be viewed in isolation. Farm practices can lead to adverse effects on other parts of the environment, including reduced water quality and wildlife habitat.

FORESTS

PEOPLE AND TREES

Forests cover nearly 45 per cent of Canada's total land area. About half this area — over 250 million hectares — is capable of yielding harvestable trees. Nine of the 15 ecozones contain over 10 million hectares each of forestland, including the Boreal Shield with over 130 million hectares. Even in the urbanized Mixed-Wood Plain, forests of commercial value cover at least 16 per cent of the land.

FORESTS AT WORK

Forests generate much of the oxygen we breathe. They consume much of the carbon dioxide we generate and remove particulate contamination from the air. Forests also collect rainwater and allow it to run off slowly. Forests are home to a great number of animals, ranging from large mammals to clouds of insects, all of which form part of forest ecosystems.

The forest industry is Canada's largest industry. Along with related manufacturing industries, it accounts for one out of every 10 Canadian jobs. Wood is also an important source of energy, both for the forest industries and for home heating. In addition, millions of people use Canadian forests for recreation; some go for casual hikes in woods near their homes; others hunt and fish; and still others travel hundreds of kilometres to reach wilderness areas far from cities.

HEALTHY FORESTS

A healthy forest contains plants of many species — some large, some small, some microscopic; some youthful, some mature, some dead and decaying (thus providing a base on which other plants can grow). More than 150 tree species are native to Canada. They grow mainly in the southern ecozones. In general, the further north you travel, or the higher you climb, the simpler the forest ecosystem becomes — fewer species and smaller numbers of each species. Eventually, you reach a zone defined by temperature, exposure, and rainfall — the so-called tree line — beyond which no trees grow.

Canada appears to be rich in forests, but because of slow natural growth rates and the thin soils that characterize northern ecosystems, our renewable forests are easily depleted.

THE STATE OF CANADIAN FORESTS

FOREST GROWTH

The temperate-climate rain forests of the Pacific Maritime ecozone — among the few remaining examples of this type of forest in the world — can generate over four cubic metres of growth per hectare each year. In contrast, annual growth in the forests of the Taiga ecozones averages less than one cubic metre per hectare. Growth rates vary widely from site to site because of human, climatic and geographic influences.

Forest regeneration can be greatly enhanced by intensive management. It can also be inhibited by the failure to prepare terrain and replant it. Canada has large areas of land that have not been replanted after being cut or where tree species and shrubs with little or no commercial value have sprung up. Classed by foresters as "insufficiently restocked", this

MAJOR STRESSES ON OUR FORESTS

Natural processes such as forest fires, insect infestations and disease place stress on forests, as do human activities like land clearing, some types of logging and air pollution. In many cases, stresses from natural processes and human activities combine to magnify the impact. We see symptoms of stress in discoloured and falling leaves, poor growth rates and eventually — if the stress is great enough — dead and dying trees. Although comparison is difficult, it appears that natural processes and human activities transform roughly equal areas of productive forest each year, each accounting for tens of millions of hectares.

NATURAL FORCES

Fires damage hundreds of thousands of hectares of Canadian forestland every year. In bad years, over two million hectares may be affected, mainly in the west and the north where natural conditions promote the spread of fires. Natural causes are responsible for 90 per cent of the area affected by forest fires, with lightning by far the greatest factor. Fires are a natural factor in the ecosystem, but they also destroy useful wood. What's more, because fires remove ground cover, they can initiate a cycle of erosion and soil loss that can destroy the potential for further tree growth. Northern forests in particular depend upon periodic fires for their long-term vigour, and species like jack pine depend on fire to release their seeds. Further south, a higher proportion of fires is caused by human activities. Land that has been logged is especially susceptible to fire damage.

Insects and disease are a normal part of life in a forest ecosystem. Even so, where forests have been subject to excessive stresses or where single tree species grow over large areas, the forest can become more susceptible to damage. Spruce budworm represents the biggest insect problem today in Canadian forests, with over 25 million hectares of dead and dying trees in Ontario, Quebec and New Brunswick alone. Also in the east, Dutch elm disease has grown from a minor problem three decades ago to a major one today, but the elm population does not appear to be in danger of extinction. In the western mountains, the pine beetle now affects almost 200 000 hectares of forest annually. Together, these three pests account for about half the total volume of wood lost to insects and disease in Canada each year.

HUMAN FORCES

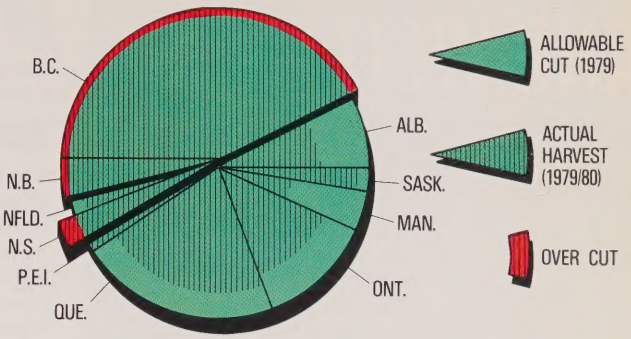
The annual harvest of wood in Canada has increased by 50 per cent since the 1950s. Careful calculations of the maximum cut that can be allowed

type of land occupies nearly 12 per cent of the total forest area in the Boreal Plain ecozone and over seven per cent in the Boreal Shield.

CHANGING FORESTS

Forest ecosystems are changing constantly. Under natural circumstances the changes are predictable over time, but land clearing and timber harvesting can cause sudden changes in both the extent of forest cover and the mix of species. We have lost almost all of the extensive white pine stands that used to blanket the Ottawa Valley and most of the centuries-old Douglas firs of the Pacific Maritime ecozone. At present, only one species is in danger of extinction (the chestnut, as a result of disease). However, in part because of recent harvesting, fires and disease, and in part because of insufficient restocking after harvest, as much as one-half of Canadian forestland contains either immature or regenerating trees — far from the age structure expected in nature.

ACTUAL AND MAXIMUM ALLOWABLE CUTS OF SOFTWOOD BY PROVINCE (000 M^3)



SOURCE: Environment Canada, Canadian Forestry Service, 1983.

confirm that we are over-harvesting our forests, particularly softwoods in the Maritime provinces and in British Columbia. Shortages are already apparent in some regions, and loggers are facing longer hauls or are having to fell less desirable species.

MAJOR INFLUENCES ON CANADIAN FOREST ECOSYSTEMS

ECOZONE	FIRE	INSECTS AND DISEASES	HARVESTING[1]	CONVERSION OF FORESTS TO OTHER USES	UTILITY/ TRANSPORT CORRIDORS[2]	POLLUTION	CLIMATE INDUCED	
							REDBELT[3]	WINDTHROW[4]
BOREAL CORDILLERA	●			●	●			
PACIFIC MARITIME		●	●	●	●	●		
MONTANE CORDILLERA	●	●	●	●	●		●	●
BOREAL PLAIN	●		●	●	●		●	
TAIGA PLAIN	●				●			
TAIGA SHIELD	●							
BOREAL SHIELD	●	●	●	●		●		●
MIXED-WOOD PLAIN		●		●		●		
ATLANTIC MARITIME	●	●	●	●		●		●

(1) Effects of cutting and forest management practices.
(2) Includes seismic lines, particularly significant in the Boreal Plain.
(3) Mortality in conifers, caused by drying "Chinook" winds.
(4) Losses at the edge of forest stand clearings.

SOURCE: State of the Environment Report for Canada, 1986.

Efforts promoting the **regeneration** of trees harvested have not been extensive in Canada. Natural regeneration can be acceptable when the species that grow back are suitable and when they grow back rapidly enough to protect the ecosystem. But only one-fifth of the area harvested between 1975 and 1980 was seeded or replanted. In Alberta, 77 per cent of the area harvested was site-prepared and nearly 60 per cent was replanted. In British Columbia and Saskatchewan, about one-third of the area harvested was replanted and, in Ontario, about one-quarter. Elsewhere, less effort is devoted to stimulating regrowth.

Forestry methods have also changed. Modern methods involve whole-tree logging, which deprive the forest of nutrients, and clear-cutting, which can lead to slides and erosion, especially on slopes. The larger the area clear-cut, the greater the potential damage. Haul roads add to the stress by compacting the soil, creating channels for erosion and raising dust levels. In some cases, the resulting situation has severely affected nearby streams. Haul roads also increase access into relatively remote areas, leading to additional stresses on wildlife and sensitive ecosystems. Intensive management of forestland can greatly increase productivity, but if it focuses on only a small range of species, it leaves the forest open to attack by pests, reduces the forage available for animals and — where insecticide spraying is involved — reduces insect and bird populations.

Forest clearing to make way for farming was once a common practice in Canada. More recently, forestland has also been lost behind large dams and to expanding cities. At the same time, some marginal farmland has returned to forest, and other areas have been placed in reserves and parks. The net effect of these land use changes is that Canada may be gaining in total forested land area — though not necessarily in commercially useful stands.

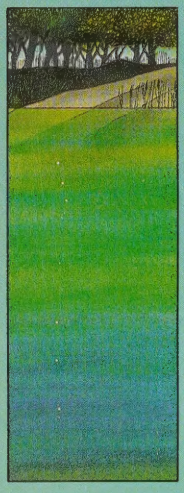
Air pollution is a newly recognized stress on our forests. Both automobile exhaust and industrial emissions contribute to this problem. There is mounting evidence that forests are affected by the long-range transport of air pollutants, including acid rain and ozone. Ozone has been shown to cause leaf damage and reduced growth rates, while acid rain has been implicated in the maple decline in Ontario and Quebec. Acid rain is discussed further in the chapter called Contaminants.

OUTLOOK

Few other countries have a heritage in forestland so rich and so important as Canada's. Our economy and our environmental quality are both linked to this renewable resource. Even so, there is strong evidence that Canada has not taken good care of this heritage. Canada is not running out of trees, but it is running out of high-quality forest. This is a problem for the Canadian forest industry, which competes with countries in warmer climates where trees mature in one-quarter to one-half the time they do here. It is also a problem for people seeking recreation and renewal in mixed forests with abundant diversity of animal life.

We have a choice. Human activities can threaten this vital resource. Equally, through sound forest management, air pollution control, and protection of sensitive forests, the well-being of the forest ecosystems can be preserved.

LAKES, RIVERS AND WETLANDS



PEOPLE AND FRESH WATER

Lakes and rivers cover nearly eight per cent of Canada's surface and have had a profound influence in shaping the nation. Historically, Canada's supply of fresh water was thought to be entirely adequate for our widely distributed population and industry. However, with agricultural use of water up by 300 per cent since 1951, municipal use up by over 200 per cent, and rapidly growing demands for recreational use, this comfortable assurance is disappearing. In the west, actual shortages are developing as demands for water approach the naturally available supply. In the east, problems are usually related to water quality.

LAKES AND RIVERS

Canadian rivers discharge nine per cent of the world's fresh water into three oceans. Our lakes and rivers are the source of drinking water for millions of people and are used extensively for recreation, transportation, industrial processing, power generation, livestock watering, irrigation and commercial fishing. Sport fishing in our lakes and rivers attracts tourists from all over the world.

WETLANDS

Another 14 per cent of Canada's surface is covered by wetlands — areas of standing water and saturated soils that support highly productive ecosystems, moderate stream flow, remove excess nutrients and assimilate some pollutants. The largest areas of wetlands are found in central, western and northern Canada. Wetlands provide staging and breeding areas for waterfowl and habitat for the development of fish. They are home to many rare or endangered species of plants, birds and fish.

LIFE IN FRESH WATER

All bodies of fresh water contain minerals, organic materials and nutrients. Concentrations vary with climate, geology, soil and vegetation. These substances are dissolved from underlying soils and rocks or are supplied in run-off of rain and snow. Nutrients are taken up by plants and microorganisms, which then become food for fish, waterfowl and people.

THE STATE OF LAKES, RIVERS AND WETLANDS

The state of lakes, rivers and wetlands across Canada can be assessed by looking at selected river basins.

FRASER RIVER

The Fraser River estuary in British Columbia is one of the world's most productive areas for fish, wildlife and agriculture. There is concern about deteriorating water quality from the cumulative effects of urban and industrial discharges, commercial shipping, logging and agriculture. Conflicts are occurring over resource use and over the threat to wetlands posed by log storage facilities, drainage for agriculture and urban expansion. Recent efforts to protect wetlands have included purchasing critical habitats for fish and wildlife or creating recreational areas.

QU'APPELLE LAKES

The amount of phosphorus entering the Qu'Appelle River system which flows through Saskatchewan to Manitoba, has been reduced through various control programs, and water quality will benefit from the installation of improved sewage treatment facilities at Regina and Moose Jaw.

STRESSES ON FRESHWATER ECOSYSTEMS

Many human activities place stresses on freshwater ecosystems. Some are discussed here, while others are examined in the chapters on Farmland, Forests, Land Use and Contaminants.

EUTROPHICATION

Eutrophication — often indicated by algal blooms — is a complex natural process whereby the biological productivity of a body of water increases. Cultural eutrophication occurs when this natural process is enhanced by nutrient enrichment from sewage discharge and run-off from agricultural fertilizers, feedlots and other sources. Advanced eutrophication results in tainted water supplies and seasonal oxygen depletion in aquatic systems, killing fish and other biota.

Run-off from nutrient-rich soils, poor agricultural practices and the discharge of inadequately treated sewage all contribute to the further enrichment of naturally eutrophic lakes in the prairie provinces south of the Canadian Shield. Lakes in the Qu'Appelle region, for instance, may be affected several times as severely as any of the Great Lakes.

In the Great Lakes, phosphorus control through municipal sewage treatment has reduced the magnitude of this problem. Eutrophication remains problematic, however, in watersheds dominated by agriculture (for example, southern Ontario, Quebec and the Okanagan Valley).

ACIDIFICATION

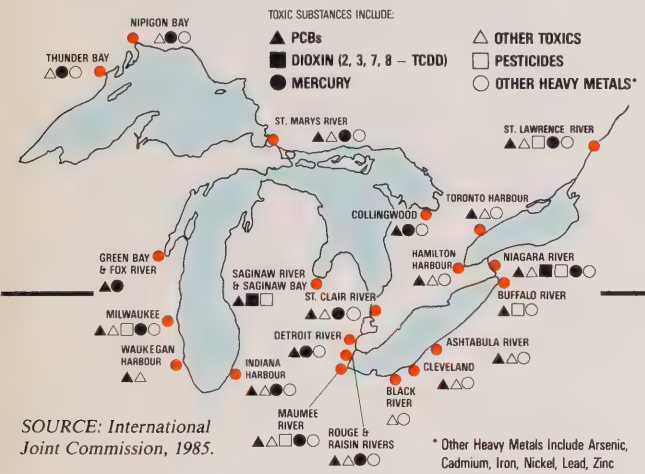
Acid precipitation is widespread in eastern North America. Many lakes and rivers of the Canadian Shield have a limited capacity to counteract acid rain; in Ontario alone, fish populations in 11 000 lakes are considered to be at risk. The most susceptible lakes are already characterized by episodes of high acidity, elevated concentrations of toxic metals and the absence of fish and amphibians. Such lakes would take years to recover even if acid precipitation ceased immediately.

Significant amounts of phosphorus are still being released, however, from the lake sediments of Buffalo Pound Lake and the Fishing Lakes on the Qu'Appelle River. These lakes have continuing algae problems — spoiling recreational areas and giving drinking water a foul taste. Pesticides from agricultural run-off are also found in the river and in aquatic organisms.

GREAT LAKES

The Great Lakes ecosystem has long been subject to stress by overfishing, the introduction of new species, sewage and industrial discharge, shoreline alterations, wetland drainage, canals, diversions and toxic contaminants. Although changes in detergent formulations and improved sewage treatment have reduced phosphorus loadings significantly over the past 10 years, deep-water oxygen concentrations are not showing much improvement. Pesticides, mercury and other persistent toxics continue to be found in some areas, even after control programs have been instituted or production banned. Some Great Lakes fisheries have recovered with improved water conditions, control of the sea lamprey, and more sensitive management practices. The walleye fishery in Lake Erie has reopened, and Lake Huron has seen the return of lake whitefish.

PROBLEM AREAS OF TOXIC SUBSTANCES IN THE GREAT LAKES



SOURCE: International Joint Commission, 1985.

TOXIC CHEMICALS

Toxics are prevalent throughout freshwater ecosystems. Originating from municipal sewage, industrial effluents, poorly managed landfill sites, pesticide use, and mining and smelting activities, they tend to accumulate in sediments and in aquatic food chains. At least 30 000 compounds are in use in the Great Lakes basin; about 800 of these are known to be toxic and many of these are persistent in the environment. For many others, the effects of long-term exposure are unknown.

The St. Clair and Niagara Rivers are large contributors of many toxic chemicals to the Great Lakes. These chemicals originate mainly in industrial plants and hazardous waste disposal sites. They are found in water, sediments and fish as far down the St. Lawrence River as Quebec City. The greater part of the toxics problem in the St. Lawrence River itself comes from tributaries in the United States, but the Montreal area also contributes significantly to the problem. Although progress has been made toward recovery of some contaminated rivers and lakes, toxics in the water environment still present many difficulties.

MUNICIPAL SEWAGE

Besides nutrients and toxics, sewage is also a source of bacterial and viral contamination. About 85 per cent of Canadians live in communities served by sewers. However, only 70 per cent of the people in the communities with sewers (or less than 60 per cent of all Canadians) are also served by sewage treatment plants — and many of these plants provide only partial treatment. Some municipalities have been reluctant to install sewage treatment, relying instead on direct disposal into rivers, lakes and oceans. Construction of plants for some major cities is now under way; new sewage treatment facilities for Montreal, for example, will greatly improve the situation in the St. Lawrence once operational.

SAINT JOHN RIVER

In the past, the Saint John River in New Brunswick has been degraded by discharges from pulp and paper mills, food processing plants and urban areas. Fish kills have occurred in some years, and seasonal oxygen depletion in the stretch of river between Edmundston and Grand Falls remains a recurrent problem. Recent clean-up measures hold out prospects for rejuvenation of the salmon population in the river.

INDUSTRIAL EFFLUENTS

Many industries discharge waste water, but three — pulp and paper, chemicals and petroleum refining — have particularly large rates of discharge. Compliance levels have been established for certain industries with positive results. During the 1970s, through improved processing and treatment, pulp and paper mills were able to cut the total load of suspended solids by nearly 60 per cent and oxygen-depleting materials by 40 per cent. Many chemicals discharged by these industries are not specifically regulated, however, and find their way into lakes and streams.

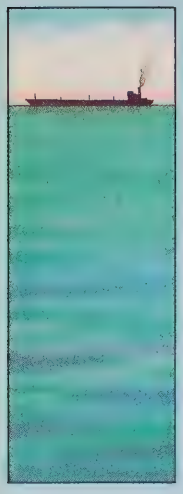
DRAINAGE OF WETLANDS

The drainage of wetlands for agricultural and urban expansion has eliminated the wildlife habitat these areas once provided. More than 50 per cent of the wetlands along the Lake Ontario shoreline have now been drained, and similar losses have occurred near Lake St. Clair and Lake Erie and along the St. Lawrence. Expansion of the five major prairie cities has eliminated between 75 per cent and nearly 100 per cent of nearby wetlands.

OUTLOOK

Canada has not experienced the severe water shortages and water quality problems encountered in other parts of the world. Nevertheless, our activities have permanently changed the ecology of the Great Lakes and degraded the quality of many other lakes and rivers. Competing demands for water use are all but inevitable in the semi-arid prairies and interior of British Columbia. Today, we are faced with the need to resolve current problems and to have the vision to avoid future water crises. In the absence of effective programs to manage Canada's freshwater ecosystems, Canadians could lose much of their freshwater heritage.

OCEANS AND SHORELINES



PEOPLE AND SALT WATER

Canada has 244 000 kilometres of coastline, the longest in the world. We also have the fourth largest exclusive economic zone, extending 320 kilometres from the coast and encompassing some 4.7 million square kilometres of ocean area. Canadian commercial fisheries, including both shellfish and finfish, already account for two per cent of the world catch, and that share has been growing year by year.

LIFE IN THE OCEANS

Productivity in a marine ecosystem depends on the amount of sunlight and supplies of nutrients reaching plants at the base of the food chain. The interaction of ocean currents, seasonal ocean turbulence, and the wind-driven upwelling of nutrients from deeper waters provides the necessary conditions for marine life.

Water temperature, the availability of nutrients, the level of oxygen dissolved in the water and the presence of contaminants all influence plants and animals found in marine ecosystems. Coastal regions — including estuaries, salt marshes, tidal flats, inlets, bays, gulfs and fjords — tend to be highly productive and serve as marine nurseries, but they are highly vulnerable to human activity. Offshore waters are generally less productive and less sensitive.

CANADA'S MARINE ECOSYSTEMS

The Pacific coast has a narrow continental shelf, less than 50 kilometres wide, and a complex shoreline of rugged mountains, inlets, fjords and islands. Fjords and river estuaries trap nutrients and may support large populations of marine life and waterfowl.

The Atlantic coast has a much wider continental shelf — more than 200 kilometres — and includes the Grand Banks. Major current systems and upwellings are found on the shelf and in large estuaries, such as that of the St. Lawrence River.

The Arctic coast has less diversity of species than is found in warmer waters. Ice cover reduces the penetration of light into the seawater and limits the production of plants. The Arctic marine environment contains many unique features, including the highly productive polynyas, which are ice-free areas caused by rapid tidal currents.

THE STATE OF OCEANS AND SHORELINES

PACIFIC COAST

Five commercial species of salmon are indigenous to the Pacific coast. Although landings of all of them have remained relatively constant over the last 30 years, the average size of the salmon caught has fallen by about 20 per cent. Also, there has been a gradual decline in wild chinook and chum salmon stocks in the Fraser River. Herring stocks are low after a partial recovery in the 1970s. Halibut stocks were rehabilitated in the 1960s, but landings have now fallen to a third of earlier levels. Populations of killer whales and sea lions have been increasing in recent years.

The Pacific offshore and the Straits of Georgia and Juan de Fuca are relatively free of pollution. However, the lower Fraser River, including Vancouver Harbour and adjacent portions of the Strait of Georgia, are affected by large sewage discharges, industrial outfalls, storm sewers, agricultural run-off and marine transportation activities. Elsewhere along the coast, similar situations are found near communities and industrial operations; the extent of the impact depends on the type and volume of the contaminant and on whether the release occurs in an enclosed area or on an open coast. Many fjords and estuaries are also used for log storage, with adverse effects on fish habitat.

ATLANTIC COAST

Intense international fishing along the Atlantic coast during the 1950s and 1960s led to a threat to fish populations. The activity of foreign vessels was

MAJOR STRESSES ON MARINE ECOSYSTEMS

Human activities introduce significant stresses on marine ecosystems, but natural stresses, such as climatic change and shifts of currents, can create even greater stress.

OVERFISHING

Overfishing is a serious concern in Canadian waters. The most dramatic illustration of how overfishing affects fish populations is the way stocks recover when fisheries management is introduced. Cod stocks on the Atlantic coast have recovered well since regulations were imposed in the 1970s. Chum salmon on the Pacific coast have also begun to recover since stock management practices were implemented.

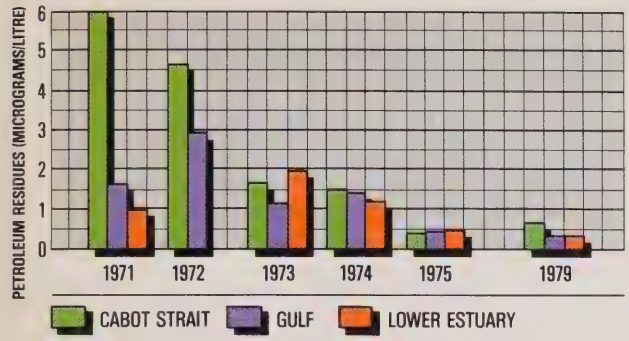
DAMS AND WATER DIVERSIONS

Large hydroelectric projects can seriously reduce the amount of nutrient-rich water entering estuaries and marine ecosystems by reducing spring run-off flows and increasing winter flows. The spring flow on two rivers flowing into the St. Lawrence estuary and gulf used to be three times the winter flow, but since the construction of dams the spring flow has been cut to only about 1.5 times the winter flow. Dams can also block or destroy spawning beds for salmon, as has occurred along the Pacific coast.

DRAINING OF COASTAL WETLANDS

The pressure to drain wetlands for agricultural, recreational and urban purposes is greatest on the Pacific coast because of the limited land area for development. In the Fraser River estuary, by 1974, 71 per cent of salt

PETROLEUM RESIDUES IN THE GULF OF ST. LAWRENCE



SOURCE: Department of Fisheries and Oceans.

reduced through a quota system and the establishment of a 320 kilometre limit to ensure the conservation of marine resources. Through fisheries management, cod stocks have been rehabilitated; however, herring stocks have not recovered as quickly due to biological factors.

Total Atlantic salmon catches have fluctuated, but average figures tend to mask problem rivers, particularly in Nova Scotia, where catches are definitely down. Some Atlantic salmon stocks suffer from overfishing and from the effects of acid rain on spawning rivers. Lobster catches have remained relatively stable although average size has decreased.

Sources of contamination of coastal waters include industrial effluents, inputs from rivers, material for ocean dumping, airborne chemicals, wastes or spillage from shipping, and municipal discharges, the latter causing 288 shellfish areas to be closed in 1985 compared to 20 areas in 1940. Contamination of offshore water results primarily from marine transportation activities and atmospheric deposition.

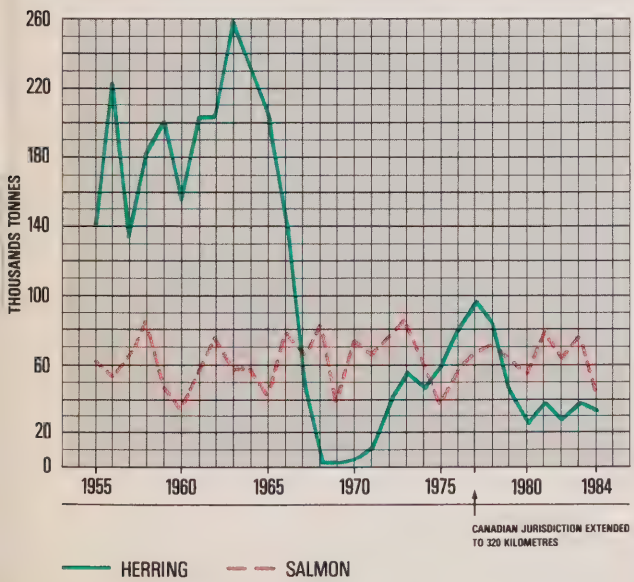
ARCTIC COAST

The main commercial fish in Canadian Arctic waters is the char, though it is harvested almost entirely from rivers or in estuaries. Stocks are relatively stable except for some localized areas where overfishing has reduced the population. Seals occur in large numbers and are hunted along much of the coast. The bowhead whale, which numbered almost 20 000 in the last century, has been reduced by hunting to only a few hundred protected animals in the eastern Arctic and about 3 000 in the western Arctic. Narwhals are widely distributed; more than 20 000 spend the summer in the Lancaster Sound area. Beluga whales and seals are found throughout the Arctic.

In Canada's north, the population is growing, mines are being opened, oil and gas exploration is under way, and other development is taking place. The Arctic is now beginning to experience effects that have long been felt on our other coasts. These include recommendations that shellfish from certain areas be avoided because of contamination from sewage; isolated incidents such as PCBs leaking from equipment at DEW Line sites; and localized pollution from oil development and shipping. In addition, fish, marine mammals and other wildlife have been contaminated with compounds transported to northern Canada by winds and ocean currents.

marsh and 30 per cent of freshwater marsh had been lost. The remaining marshes are habitat for juvenile salmon and other fish and support large populations of wintering and migrating waterfowl.

CANADIAN COMMERCIAL CATCH IN THE NORTHEAST PACIFIC



SOURCE: Department of Fisheries and Oceans.

POLLUTION

Coastal areas are more heavily stressed by pollution than offshore areas. In some locations on the Pacific coast, effluents from the pulp and paper and mining industries have smothered the bottom habitat and reduced oxygen levels in the water. On the Atlantic coast, a number of rivers discharge industrial wastes into the ocean — wastes that can originate as far away as central Canada. Sewage discharges have closed shellfish fisheries on both coasts, and heavy metals have been found in some coastal species. Both coasts also suffer from oil pollution, which is discussed in the chapter entitled Canada in the Global Setting. Only a few local problem areas are known in the Arctic at present — but resource developments are increasing. The cold, ice-dominated marine ecosystem may break down or disperse contaminants much more slowly than southern ecosystems.

OUTLOOK

Though seemingly vast, marine environments and their resources are all too easily depleted or devalued in the absence of good management. Those surrounding Canada are no exception. On one hand, our marine ecosystems are being threatened by overfishing, major energy projects and pollution. On the other hand, some fish stocks are responding to management, some pollution sources are being reduced, and attempts are being made to minimize effects on estuaries and bays. Furthermore, we have an opportunity to apply lessons learned from the Atlantic and Pacific as development proceeds northward into the Arctic.

WILDLIFE

PEOPLE AND WILDLIFE

Nearly 200 species of mammals — five per cent of the world's total — and 400 species of birds are found in Canada. There are also 82 species of reptiles and amphibians, over 100 000 species of invertebrates and 3 300 species of plants. The term 'wildlife' has come to refer to all animal and plant species that together make up the living portion of any ecosystem. Each species, no matter how seemingly insignificant, contributes to ecological balance and stability.

CANADA'S HERITAGE

Animals played a special role in Canada's early development. Beaver, fox, otter, muskrat, mink and marten once supported a large fur trading industry that was instrumental in opening up Canada's vast territories. Bison, antelope, caribou and elk, as well as marine mammals — whales, walrus, seals — provided food and clothing for the Indian people and Inuit and later became a major source of livelihood for them and for many of Canada's immigrants. Today, the harvesting of furbearing mammals provides an income for thousands of Canadians, while Canada's big game animals and abundant game birds and fish support a thriving hunting, fishing and tourist industry.

WILDLIFE AND HABITAT

Canada has a wide diversity of natural habitats, including grasslands, deciduous and coniferous forests, tundra and alpine terrain. Each has its own distinct assemblage of plants and animals, adapted to life in that particular habitat.

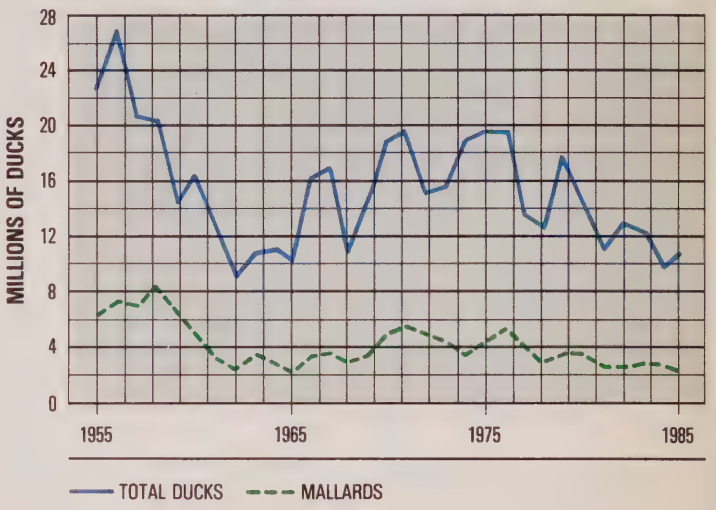
Different species of wildlife have different habitat needs. Animals such as bears and wolves need large areas over which to range, while other species prefer to live around farms or even in urban areas. Some species are adapted to a wide range of habitats, while others have narrowly defined needs. Some species live in one area year-round, coping with seasonal changes while others migrate.

Because of the dependence of each species of wildlife on certain features in its environment, any change will have significant effects on wildlife numbers and distribution.

THE STATE OF CANADIAN WILDLIFE

The populations of most species of Canadian wildlife are generally stable or increasing. The exceptions include some ducks and swans, certain furbearers (lynx), some populations of bison and caribou, and reptiles

NUMBER OF DUCKS IN THE CANADIAN PRAIRIES



SOURCE: Environment Canada, Canadian Wildlife Service.

STRESSES ON WILDLIFE

Wildlife under stress demonstrate a wide range of responses. Severe stress leads to declining numbers, migration and possible extinction. Some species, however, demonstrate remarkable adaptability. Fifty years ago, it was predicted that the ring-billed gull would disappear from Canada. Today, with abundant garbage on which to feed and nesting sites along the shore, the gull population around the Leslie Street spit in Toronto has grown from 20 to an estimated 80 000 pairs.

AGRICULTURAL EXPANSION

Although some species of birds and small mammals have benefitted from the growth of agriculture, the broad effect has been a loss of wildlife habitat. In the Prairie, Mixed-Wood Plain and Pacific Maritime ecozones, several million hectares of wetlands that provided habitat for local species, as well as staging and nesting areas for millions of migratory birds, have been lost. In some areas of southern Ontario, Manitoba and Saskatchewan, 50 to 85 per cent of the wetlands have been altered by human activities. Expanding agriculture has eliminated much of the prairie aspen parkland and most of the natural grassland that provided good cover for birds and mammals. As a result, the blackfooted ferret, the swift fox and the antelope have become rare. In contrast, the abandonment of marginal farmland, especially in the Atlantic Maritime and Mixed-Wood Plain ecozones, along with subsequent natural reforestation, have allowed deer and small mammals to repopulate these areas.

RESOURCE DEVELOPMENT

Hydroelectric developments can destroy major areas of wildlife habitat. The James Bay project on the La Grande and Eastmain rivers flooded large areas in the eastern portion of the Taiga Shield ecozone, with significant

and amphibians. Despite this generally favourable national picture, about 45 species of animals and plants are endangered, and some regional populations have been seriously depleted. Loss of habitat caused by human activities is the major factor contributing to this decline.

ENDANGERED WILDLIFE

Species listed as endangered are faced with immediate extinction over most of their range owing to human actions. The current list of endangered species in Canada is as follows:

MAMMALS	BIRDS	FISH	REPTILES	PLANTS
Eastern cougar	Eskimo curlew	Acadian whitefish	Leatherback turtle	Cucumber tree
Vancouver Island marmot	Greater prairie chicken	Gravel chub		Furbish lousewort
Wood bison	Kirtland's warbler			Heart-leaved plantain
Bowhead whale	Peregrine falcon			Pink coreopsis
Right whale	Piping plover			Pink milkwort
St. Lawrence beluga	Whooping crane			Prickly pear cactus
Sea otter				Small white lady slipper
				Small whorled pogonia
				Southern maidenhair fern
				Water pennywort

In addition, at least three species of bird, two fish species and the Dawson caribou are now considered extinct, and two more mammals are listed as extirpated (no longer found in Canada but existing elsewhere). Other populations are now stable but at much lower numbers than formerly. The plains bison, which may once have numbered two million, now numbers only 2 000, and the antelope, which numbered in the hundreds of thousands, has been reduced to between 10 000 and 20 000.

Some endangered species are being saved through committed conservation efforts. Wood Buffalo National Park, for example, established in 1922, has provided sanctuary for the breeding ground of the world's entire wild population of whooping cranes. Their population in the park grew from 15 adults in 1941 to 85 in 1985. Similarly, 18 wood bison, captured in 1963 and transported to the western shores of Great Slave Lake, have grown to a herd of over 1 000 — the world's largest herd of these animals.

UNIQUE AREAS

Canada has many areas that are unique because of their wildlife productivity or because of the assemblage of wildlife they contain. Southern Canada contains numerous areas with collections of plants and animals that survived the last ice age. Further north, Hudson Bay has a high density of denning sites for polar bears, and Lancaster Sound north of Baffin Island is noted for its high population of marine mammals and sea birds. The Queen Charlotte Islands, including South Moresby, contain a higher number and greater variety of unique species than any other place of comparable size in Canada. They contain one of the world's greatest concentrations of Peale's peregrine falcon and the highest density of nesting bald eagles in Canada.

losses of moose and furbearing animals.

Forestry produces mixed effects. In the Montane Cordillera ecozone, forest clear-cutting is beneficial to moose, deer and elk, which require new growth for food, but detrimental to mountain and woodland caribou, which feed primarily on tree lichens. Coniferous plantations tend to reduce wildlife productivity as they provide little food or undergrowth for small animals.

As resource development moves into new areas, stresses mount on wildlife in the affected ecosystems. In the Boreal Plain, an area about the size of New Brunswick either has been lost as habitat or is experiencing reduced wildlife productivity. Tailing ponds associated with development of tar sands deposits pose a particular problem. They are warmer than surrounding natural ponds and are open later in the fall — but birds alighting on them may become coated with oil and drown.

HUNTING AND TRAPPING

Hunting and trapping puts pressure on some species. In the 1982-83 season, about three million pelts were taken. Muskrat, beaver and squirrel provided about 75 per cent of all pelts taken. In the same season, kills of large mammals by Native people and sport hunters numbered more than 300 000. Deer and moose accounted for more than 75 per cent of hunting kills.

Hunting and trapping are generally controlled to prevent overharvesting and consequent depletion. Harvest and accidental kills of polar bear, for example, amount to six or seven per cent of the population, well within sustainable limits. Where adequate control is not exercised, populations can fall dramatically. In the 19th century, at least 15 000 muskox were killed for their skins. Fifty years later, only a few small herds remained. Since then, with the restriction of hunting and the establishment of sanctuaries, the muskox population is recovering.

THE INFLUENCE OF CLIMATE

Climatic cycles can have an influence on wildlife. The prolonged drought experienced in the Prairie ecozone since 1976, accompanied by continued conversions of wetlands to agricultural uses, has resulted in a decrease in the availability of ponds and adjacent cover for ducks. By 1985, the total number of ducks on the Canadian prairies had declined by 60 per cent compared with 1955, when the Prairies were exceptionally wet.

OUTLOOK

Wildlife has played a special part in the development of Canada and continues to play a role in the lives of all Canadians, particularly Native peoples. Although laws controlling hunting and trapping are important, the greatest stress on wildlife today is not hunting or trapping but loss of habitat. In addition, remote sanctuaries are needed so that a full assemblage of animals can live, reproduce and die in circumstances as unaffected as possible by human beings. Comparable offshore areas may be needed for whales and other sea mammals. Taken together, controls on harvest and protection of habitat will ensure that our wildlife heritage can be passed on to our children.

LAND USE

PEOPLE AND LAND

Canada contains nearly 10 million square kilometres* of land, about seven per cent of the world total. This includes 750 000 square kilometres of freshwater area — more than in any other country. Our land resource provides the basis for a great variety of activities, ranging from food production, forestry, and mineral and energy extraction to settlement and recreation. The esthetic needs for open space and natural beauty are met through parks and other areas.

IMAGE AND REALITY

At first glance Canada appears richly endowed, and in a sense that is true. Roughly 40 per cent of our gross national product and 25 per cent of the jobs in Canada are related directly to the extraction, harvesting and processing of raw materials. With a population of 25 million, Canada has a population density of 2.5 people per square kilometre. However, neither our lands nor our resources are as abundant as many people believe. Topography, soil conditions, rainfall and climate limit the readily habitable portion of Canada to about 25 per cent of the total land area. Consequently, a more careful look at Canada's lands shows not only a much different set of ratios (10 people per square kilometre, not 2.5), but also that virtually all the readily habitable portion is already in use. Moreover, the same lands that are most capable of growing food or trees also afford the best conditions for building cities and towns, for locating industries and transportation networks and for recreation. In short, pressures on renewable resource lands have been mounting.

CHOICES

Virtually every form of sustained human activity results in some change in land use. Natural circumstances, such as flooding, drought and fire, also influence land use. Whatever the cause, land use changes involve trade-offs between 'before' and 'after' conditions. For example, major hydroelectric dams can flood large areas, dramatically changing the habitat of indigenous animal species, yet they provide energy to satisfy urban or industrial demands. Attitudes toward such changes vary widely, but they also change over time. For example, more leisure time may bring about demands for more parks and recreational lands; lack of other economic opportunities may lead to demands for increased exploitation of forest or mineral resources located on those same lands.

* One square kilometre equals 100 hectares.

CURRENT CANADIAN LAND USE

AGRICULTURE

About 11 per cent of Canada's land is considered capable of supporting agriculture, but only five per cent can produce field crops (those that requi tilling). Thus, although Canada is the second largest country in the world, the area capable of crop production is about equal to the size of Sweden. In addition, most of Canada's agricultural lands are located in areas subjec to intense pressures from urban expansion. Nearly 90 per cent of Canada's best farmland is located within 160 kilometres of our major urban centres.

SETTLEMENTS

Canada's population is concentrated in a narrow band, 200 kilometres wide and stretching 6 500 kilometres from coast to coast. Even within this band, our population is unevenly distributed. The three largest metropolitar areas — Montreal, Toronto and Vancouver — account for about one-third of the total population. The 1 200 kilometre portion of the band from Windsor to Quebec City contains only two per cent of the land area but 55 per cent of the population (and population densities close to 70 people per square kilometre). Further, cities continue to expand onto agricultural land. In one five-year period alone in the late 1960s, 90 000 hectares of land, nearly two-thirds of it with high agricultural capabilities, were lost to urban expansion. The total of all built-on lands was 175 per cent larger in 1980 than in 1950. This amounted to 2.6 million hectares, or 0.3 per cent of the total Canadian land area.

MINERAL AND ENERGY PRODUCTION

Despite Canada's role as a world producer of minerals, only about 300 000 hectares of land (less than 0.03 per cent of the total land area) have been

STRESSES ON LAND

Canada no longer has an abundance of new frontiers. Yet pressure to produce more lumber and pulp, develop more recreation spaces, and expand our cities, towns and transportation networks continues to grow. In most cases, each of these demands places pressure on the same southern portion of Canada's lands.

INCREASED URBANIZATION

Prime renewable resource land now constitutes a major source of land for urbanization. Between 1976 and 1981, nearly 100 000 hectares of rural land were converted to urban uses. Fully half this land was farmland of the highest quality; in Ontario the loss represented four per cent of all prime farmland. At present, urban centres with populations under 100 000 are expanding more rapidly than larger centres.

TRANSPORTATION NETWORKS

The use of land for transportation corridors has increased at a rapid pace over the past 25 years. Since 1960, electrical transmission corridors have increased by 80 per cent while gas pipeline corridors increased by over 200 per cent. Paved roads have more than doubled. Only for railroads has the use of land decreased slightly since 1960. The main stress resulting from transportation networks, however, is not the land they require but the increased access they provide to remote areas containing sensitive ecosystems.

taken for mining (including waste disposal sites). Exploration, production and movement of Canada's mineral and energy resources use over 100 million hectares, about 11 per cent of the total, but this land is generally available for other uses at the same time. Hydroelectric reservoirs are a partial exception. They cover 1.6 million hectares and almost inevitably flood valleys and obliterate free-flowing rivers, with consequent changes in wildlife habitats and in the nature of human activities.

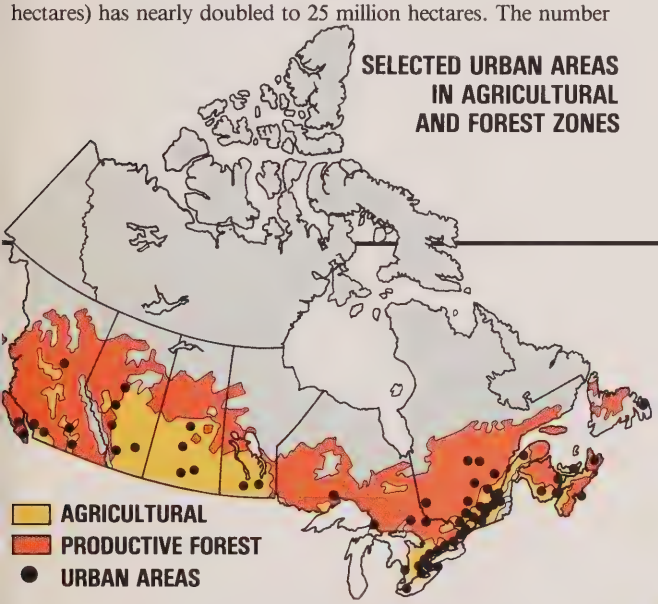
CONSERVATION LANDS

From an ecological point of view, there are strong reasons to protect certain areas that contain unique features as well as areas that, while not unique, are representative of specific ecosystems. Many of these areas are included in national and provincial parks, wilderness areas, ecological reserves and wildlife management areas.

The first Canadian national park (Banff), was established just over 100 years ago in 1885. Since that time, Canada has continued to expand its national parks system, although it still does not include representative natural areas from each major region of Canada. There are now 31 national parks protecting 13.5 million hectares. The provincial park system has expanded as well. Since 1961, the amount of land originally set aside in federal and provincial wilderness reserves (approximately 14 million hectares) has nearly doubled to 25 million hectares. The number of natural recreation reserves of smaller size has tripled to about 7.5 million hectares. Only about half the wilderness areas and 11 per cent of the recreation areas are considered fully protected from resource exploitation and other uses that might detract from their value for recreation and nature study.

SOURCE: Statistics Canada.

Several protected areas in Canada have been recognized under international conventions as having global significance. Five areas have been designated as Natural World Heritage Sites: Wood Buffalo, Kluane and Nahanni National Parks, the four Rocky Mountain Parks (Banff, Jasper, Kootenay and Yoho) and Alberta's Dinosaur Provincial Park. UNESCO has also designated two biosphere reserves: Waterton Lakes National Park in Alberta and Mont St. Hilaire in Quebec.



SOURCE: Environment Canada, Lands Directorate.

GROWING ENERGY DEMAND

Canada's quest for new indigenous energy supplies has also resulted in significant land use changes. Between 1951 and 1981, the number of hydroelectric dams increased from 203 to 576, while their storage capacity — a general indicator of potential for ecological change — grew nearly ten-fold to 765 000 million cubic metres. Until the end of the 1960s, the fast-flowing rivers of the Boreal Shield provided most of the hydroelectric power for industry in the Mixed-Wood Plain. Since that time, the Taiga Shield, a more remote northern ecozone, has experienced strong growth in hydroelectric development. Although the area involved directly in these developments is small, the stresses they impose extend well beyond the actual area where the land use change occurred.

INCREASED RECREATIONAL DEMAND

In Canada, a growing population, higher incomes and greater urbanization have led to strong demands for recreation lands and accessible green space. Most of the land giving access to lakes close to major urban areas is privately owned and is largely unavailable to the public. Recreational areas such as Muskoka, the Laurentians and the Gulf Islands are subjected to severe environmental stress as city residents seek respite from their urban environment. In addition, the rapid expansion of resource development activities in remote and previously unspoiled wilderness areas has increased the demand to preserve and protect wilderness and unique natural areas.

OUTLOOK

In Canada's earlier days, our natural environment could accommodate most if not all the demands imposed by a small population. We now know that there are real limits to our land resource. Increasingly, Canadians have to reassess land use practices in light of these limits and confront difficult decisions about who uses land and for what purposes and about how our lands should be managed and maintained. The concerns Canadians have for natural areas are reflected by the extensive system of national and provincial parks.

CONTAMINANTS

Contaminants in the environment are of concern when their presence or concentration is known or thought to be associated with adverse effects on ecosystems or human health and well-being. Contaminants such as arsenic, lead, mercury and uranium are found in the environment both naturally and as a result of human activities; others, like PCBs, mirex, and DDT are solely man-made. Some compounds may be biological in nature, developing naturally under specific environmental conditions (e.g., mycotoxins in foods).

We have long been aware of the occupational health hazards to workers dealing with asbestos and other materials. Similarly, we know of the ill effects of sudden exposure to releases of toxic substances, as occurred with methyl isocyanate at Bhopal, India, and dioxins at Sevesso, Italy. Long-term exposure to toxic substances is also known to be a serious problem, as shown by the effects of mercury on the Grassy Narrows Indian Reserve in northern Ontario. We are now recognizing, however, that there can be hazards to people and to the stability of ecosystems resulting from extended exposure to contaminants at levels that were not previously regarded as harmful.

Great strides have been made in our ability to separate and measure small amounts of contaminants in the environment. Each year, more chemicals are detected in concentrations ranging from parts per million to fractions of a part per trillion. Unfortunately, however, the long-term health and environmental effects of most of the chemicals now being found in the environment are not known. We *do* know that there are problems associated with certain organic compounds (such as PCBs) and certain heavy metals (such as mercury). We also know that some groups of individuals (such as children and elderly people), some individuals, and some ecosystems are generally more susceptible to environmental contaminants than others. Finally, we know that the combined effects of some contaminants can be particularly significant.

In short, we know that contaminants affect ecosystems and human health, but the extent is not fully understood. This chapter discusses those contaminants that are relatively well understood.

CONTAMINANTS AND ECOSYSTEMS

ACID PRECIPITATION

Acid precipitation comprises snow, fog and dust as well as rain. Acid precipitation represents the most serious environmental problem facing eastern North America. The problem begins when sulphur and nitrogen oxides are released into the air. Metal smelters and coal-fired electricity generation are the major sources of sulphur dioxide in North America, while automobiles are the major source of nitrogen oxides. Prevailing winds can carry emissions hundreds of kilometres from their source. When the sulphur and nitrogen oxides combine with water vapour, the result is acidic precipitation.

Sulphur dioxide emissions in Canada peaked in the mid-1960s, then began to decline, falling by 30 per cent by 1980. Emissions in the United States have continued to increase. Over the same period, nitrogen oxide emissions increased proportionately more rapidly in Canada than in the United States. Overall, about 50 per cent of the acid rain affecting Canada originates in the United States.

The effects of acid precipitation vary with the acidity of the deposition and the ability of the soil, water and rock formations to neutralize it. About 43 per cent of the two million lakes in Ontario and Quebec, as well as 40 per cent of the productive forest area in Canada, are located in areas that receive moderate to high levels of acid deposition *and* are at least moderately susceptible to damage. In the Muskoka-Haliburton tourist area of Ontario, 65 per cent of the headwater streams that have been sampled show elevated acid levels. Indeed, 25 per cent of the sampled streams have acid levels high enough to affect the survival of young fish. Nine out of 27 salmon rivers in Nova Scotia can no longer support salmon fry or trout. Buildings, bridges and other structures also suffer as the acid slowly erodes stonework and concrete.

CONTAMINANTS AND HUMAN HEALTH

URBAN AIR

Routine monitoring in urban areas has shown a substantial improvement in air quality during the last decade. Reductions have occurred in the average concentrations of major contaminants: particulates (down 35 per cent), sulphur dioxide (down 30 per cent) and nitrogen oxides (down 25 per cent in urban areas, although emissions nationally have increased). These gains result from a combination of factors, including the increased use of cleaner fuels such as natural gas, more efficient fuel use practices resulting from higher world energy prices, the introduction of emission controls on automobiles, the installation of pollution abatement equipment by industry and, to some degree, the construction of high smokestacks.

In addition to the well-known pollutants just mentioned, a number of other contaminants (including organic chemicals and some heavy metals) are known to be present in urban air. One specific pollutant of concern today is ozone, a particularly reactive form of oxygen that can harm the human respiratory system and reduce plant growth. Monitoring for ozone has shown no clear upward or downward trend in the levels present in urban air, but transfer of this gas through the atmosphere for hundreds of kilometres has been recorded.

DRINKING WATER

Water treatment is a well-established procedure, and treatment facilities

PESTICIDES

Pesticides (a general term that includes herbicides, fungicides and insecticides) are intended for local use but become dispersed by air and water movements. Some pesticides accumulate in fish, fish-eating birds, bottom sediments of lakes, rivers, and oceans and other parts of the environment.

Herring gull eggs serve as useful indicators of pesticide concentrations in the environment. Sampling of eggs from the Great Lakes shows that levels of DDT (which was largely banned for use in 1972) have been declining since 1974. For dieldrin (also banned in 1972) the decline has been slower. Dioxins, which occur as contaminants in a number of industrial products, including pesticides (and also as byproducts of combustion), have been found in herring gull eggs and in the tissue of some fish species.

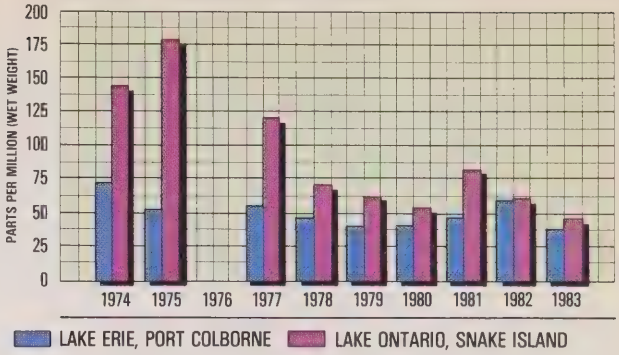
HAZARDOUS WASTE DISPOSAL

Over three million tonnes of hazardous wastes are generated in Canada every year — enough to fill Toronto's CN Tower 50 times over. Disposal of PCBs represents a small but significant part of this problem. Heavy metal solutions and residuals account for about 40 per cent of the total, with the other 60 per cent about evenly distributed among solvents, oils and greases, oil/water mixtures, organic and oily residues and other categories. Over 75 per cent of the wastes are generated in two provinces, Ontario and Quebec, and 15 per cent in two more, Alberta and British Columbia. A recent study identified 10 000 active and inactive waste disposal sites. Out of the 10 000, some 500 were identified as requiring further investigation of their potential to harm health and the environment.

HEAVY METALS

Heavier elements, such as arsenic, cadmium, lead and mercury, enter the environment as a result of natural erosion of mineralized rock and through waste discharges from mining and industrial activities. Minute quantities of these elements can cause health problems in people and animals.

PCB LEVELS IN HERRING GULL EGGS

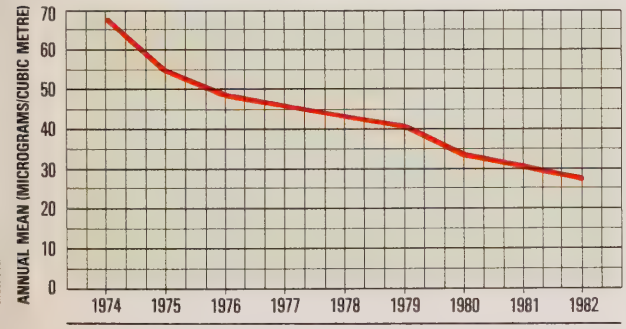


SOURCE: Environment Canada, Canadian Wildlife Service.

Some 11 500 tonnes of lead were emitted to the atmosphere in Canada in 1982 — two-thirds from motor vehicle emissions, one-third from industrial processes. In the last 10 years, lead concentrations in urban air have fallen by 60 per cent on average — in part due to control of lead levels in gasoline. Despite this general improvement, pockets of high concentrations remain, particularly around lead smelting industries.

Another heavy metal — mercury — originates from natural sources and from older gold-mining and paper-making processes. Long-term consumption of fish containing elevated levels of mercury causes irreversible nerve damage in human beings (Minamata disease). Levels of mercury have been high enough to restrict or close fisheries on a number of lakes and rivers. Levels in fish from the English-Wabigoon river system — Canada's best known mercury pollution problem — are still above safe levels. Commercial fisheries remain closed, and anglers are advised that there are health hazards associated with frequent consumption of fish from these waters.

LEAD CONCENTRATION IN URBAN AIR



SOURCE: Environment Canada, Environmental Protection Service.

serve 80 per cent of the Canadian population (but only 40 per cent of those living in communities of fewer than 2 500 people). Even so, scarcely a year goes by without some communities having to boil water because treatment systems have broken down or become overloaded during spring run-off. Moreover, present treatment methods concentrate on removing bacteriological contaminants and are not designed to reduce concentrations of synthetic organic chemicals or heavy metals. Removing these substances requires costly advanced treatment of water.

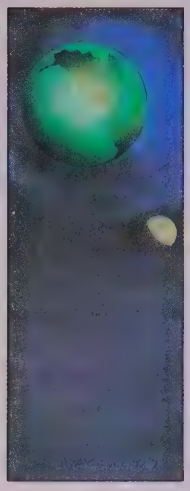
FOOD

Contaminants become concentrated inadvertently in food as residues from pesticides, from environmental pollution and from natural sources. As well, some additives are introduced deliberately to improve the appearance, the convenience of, or the shelf life of certain foods. Limits on these additives are set on the basis of information about toxicity, the quantity of the food likely to be eaten, and other sources of exposure to the chemical. With some exceptions (mainly freshwater fish), concentrations of pesticides and heavy metals in common foods appear to be within acceptable limits. Advances in science and technology will no doubt continue to uncover new information on the health implications of contaminants in food.

OUTLOOK

Air, water and land have been used as depositories for our wastes and residuals — these create stresses on the very environment in which we live and work. Since we are an integral part of the environment, contaminants often found in wastes and residuals can pose significant health risks. The solution to this situation requires the development of both technological processes that do not create environmental contamination and the improved management of toxic chemicals that are considered necessary for our society. What is required is a cradle to grave approach — one which examines the complete cycle starting with the production and ending with the ultimate disposal of chemicals.

CANADA IN THE GLOBAL SETTING



ONE WORLD

Canada is part of a world that is increasingly interdependent — economically and environmentally. Compared with what occurs within any one country, the global forces — ocean currents, atmospheric movements, population migrations — are more complex and more powerful; of greater impact, yet less well understood. Analyzing global environmental problems, and much more so resolving them, requires agreements among many governments with widely differing political views and representing a multitude of cultures, each government with its own priorities and its own concept of environment.

As Canadians, we cannot ignore the global setting of many of our environmental problems. Just as we are not exempt from transboundary problems, neither are we exempt from long-term changes in the state of the world's oceans, atmosphere and climate. Moreover, Canada's natural resources will surely be called upon to help redress global imbalances in supply and demand in coming decades. Finally, Canadians may be relatively small players on the world economic scene, but to some degree — in the way we use our resource base and in our high level of consumption — we are part of the environmental problem. It is only by looking at global problems that we can recognize the global consequences of our actions.

POPULATION AND INCOME

The world population problem is a multiple of two factors: the number of people and consumption per person. Together with the technologies used, these factors go far toward determining demands for energy, food and materials, which in turn determine the effect of population on the global environment.

World population has now reached five billion and continues to grow rapidly, though in recent years the rate of increase has declined a little. The greater

THE NATURAL RESOURCE BASE

AGRICULTURAL RESOURCES

Grains are the most basic of foodstuffs. World grain production has increased by about one-third since 1970. Although production per capita continues to grow, the rate of increase is less than it has been. Africa, plagued by drought, has seen its per capita grain production fall by 13 per cent over the same period.

Up to now, higher world grain production has been made possible by bringing more land into production, by improved seed selection and by large inputs of fertilizer and energy. It is not clear whether further gains in production, or even current levels, are sustainable. Per capita availability of arable land has been declining for 15 years, and at least one-fifth of the world's cropland is losing topsoil at a rate high enough to jeopardize long-term productivity. Other problems, such as salinization and the loss of disease-resistant strains, are also affecting food production, as is the loss of food-growing land to other uses.

FISHERIES AND AQUATIC RESOURCES

In the two decades between 1950 and 1970, new technology and cheap fuel permitted a huge increase in the fish catch. The annual harvest more than tripled; even with rapid population growth, this

THE GLOBAL COMMONS

Historically, the commons were village grazing pastures shared by all the local herdsmen. In modern times the term has come to refer to those natural resources characterized by free access for all who want to use them. Economic theory teaches that there is a strong tendency for such resources to be over-exploited, and that appears to be the case with the global commons.

THE ATMOSPHERE

The blanket of air that surrounds the earth is changing as a result of waste emissions. Carbon dioxide is of special concern because of the greenhouse effect and its potential effects on climate. Human activity now releases about five billion tonnes of carbon into the atmosphere each year, mainly as a result of burning fossil fuels. At the same time, loss of forest cover eliminates a 'sink' for carbon dioxide (because a standing forest uses carbon dioxide in photosynthesis).

The concentration of carbon dioxide in the atmosphere has grown by one-third over the last century. In addition, the continued release of other gases may be becoming as important a climatic influence as carbon dioxide. Over time, these conditions may lead to an increase in the earth's surface

part of this growth will occur in the developing countries, which are straining to provide for the people that already exist. In some African countries, population growth rates exceed three per cent a year, which means a doubling of population every 20 years. Lately, most developing countries have begun taking measures to control population growth; family planning programs, for example, have become more widespread. Experience shows that population growth tends to decline with gains in education and in equity of economic opportunity.

World income has grown more slowly than population, but it is even less evenly distributed. High per capita incomes are shared by a relatively small group of industrialized countries, mainly in the northern hemisphere. A few more countries can be listed as middle income. All other countries trail well behind in per capita income. The average person in a wealthy country consumes 20 to 40 times as much in goods and services as a person in the poorer countries. This higher level of consumption is reflected in the amount of meat we eat, in our preference for automobile and airplane travel, in the abundance of throw-away products we use, and much else — all of which require higher levels of materials and energy use and thus place greater stress on the environment.

meant more than a doubling of per capita catch. Fish is an excellent source of protein, and demand is expected to continue to climb, but the catch is no longer responding so rapidly. Few unexploited fishing grounds remain. At least 25 of the world's major fishing grounds are seriously depleted because of overfishing, and many other fisheries are suffering from high levels of pollution. The question of sustainability is particularly critical to people in the Third World, whose needs will increase from 40 per cent to 60 per cent of the global catch by the end of the century.

FOREST RESOURCES

In 1955 forests covered about one-fourth of the world's land area. They have been disappearing at a rate of 15 to 20 million hectares a year and now cover only one-fifth. Tropical rain forests are being depleted more rapidly than any other major ecosystem. The greatest problems arise in the developing countries, which stand to lose 40 per cent of their remaining forests by the year 2000 as a result of harvesting, land-clearing for agro-industrial projects, and growing demands for fuel wood and charcoal. (Wood fuels are used mainly in cooking and have become more important as petroleum-based fuels, notably kerosene, have become more expensive.) In the typical absence of reforestation, the results of over-cutting are twofold: (1) growing shortages of wood, which can reduce the economic capability of the nation and force villagers to spend ever more of their time in the search for fuel (or to use dung in its place instead of allowing it to be returned to the soil); and (2) massive soil erosion, which in turn increases the rate of run-off and adds to flooding of agricultural lands and settlements downstream.

GENETIC DIVERSITY

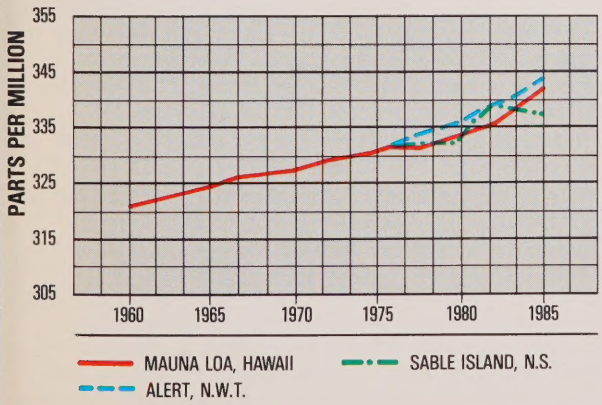
The term genetic diversity refers to the enormous range of species populating the earth *and* to the great variation found within most individual species. This diversity has been a key to the development of more productive crops, new medicines, pest-resistant plants and various other commercial gains.

Now, the diversity of the gene pool appears to be declining, as commercial pressure focuses interest on a few highly productive strains. For instance, four varieties of wheat account for 75 per cent of the Canadian crop, and almost all Brazilian coffee trees derive from a single variety. We may be losing even more species as a result of habitat destruction. One-quarter of all mammal species in western countries are now considered threatened. The destruction of tropical rain forests threatens thousands of other species, mainly insects.

In response to these problems, seed banks are being established, but they concentrate only on those plants already identified as commercially useful. Apart from the establishment of scattered natural areas around the world, little or nothing is being done to protect the other gene pools.

temperature of several degrees Celsius in the mid-latitudes and more toward the poles. Such changes would be unprecedented in human history. By shifting rainfall patterns, they could make much of the grain belt across the United States and the Soviet Union less productive. Although the same forces would shift the grain belt northward and therefore benefit Canada, northern soils tend to be poorer in quality, and world food production would likely decline.

CO_2 CONCENTRATION IN THE ATMOSPHERE



SOURCE: Environment Canada, Atmospheric Environment Service.

THE OCEANS

The world's river systems deposit about 23 billion tonnes of material into the oceans every year. Some of this material is natural, the result of geological processes, but much is the result of human activities. Most of the suspended material is deposited in coastal and estuarine ecosystems, which are critical habitats for fish, birds and mammals, including important commercial species. In addition, over three million tonnes of oil enter the oceans each year. About 12 per cent stems from major tanker accidents, 33 per cent from routine marine shipping; most of the rest is from municipal and industrial sources (37 per cent), atmospheric deposition (nine per cent) and natural sources (eight per cent). The effects of oil releases are visible on the shoreline for many years as the oil slowly breaks down. Large numbers of marine birds can be killed, especially during periods of cold weather and calm water.

HOW ARE WE DOING?

MIXED EVIDENCE

Although many Canadians believe that environmental quality is declining (Decima Quarterly Report, summer 1985), the evidence is mixed. We are harvesting more renewable resources, such as crops, fish and timber — but there is growing evidence of depletion in the resource base from which these products are drawn. Canadians continue to change land uses and alter wildlife habitats in both urban and remote regions — yet relatively few species are listed as endangered. We have more protected areas than we did a decade ago — yet several ecozones have no designated parks or wildlife reserves, and many unique natural areas remain unprotected. Offshore and arctic ecozones remain relatively free from pollution — but resource development is proceeding into these regions, and we are not sure how to cope with all possible dangers. Some of the bacteriological and chemical contaminants we were concerned about even five years ago are beginning to be controlled, and concentrations of common contaminants in urban air appear to be declining. On the other hand, new chemical compounds are constantly being introduced, and we are becoming aware of problems with persistent contaminants and adverse effects of individual contaminants at lower concentrations. The combined effects of several contaminants can be greater than the sum of the effects of the individual contaminants.

If it is possible to draw these diverse trends into a single theme, it would probably be that there is good news and bad news. In terms of **quantity,** most parts of Canada (with the possible exception of the Prairies) are in no danger of running out of water or habitable space; of exhausting all our forests, fish or land resources; of suffocating in industrial emissions. From other perspectives, however, whether it's resource harvesting, land use, or management of wastes, we do see much evidence of declining environmental **quality.** Foresters have to go further to find good-quality timber; farmers have to add more chemicals to make up for losses in soil quality; hikers have to travel longer distances to find relatively undisturbed habitat; all of us have to worry more about subtle effects from the air we breathe, the water we drink and the food we eat.

CANADIANS ARE CONCERNED

Public opinion polls show that Canadians are concerned about their environment — in fact, more so than almost any other issue. Although specific concerns vary somewhat from year to year — acid rain and toxic chemicals topped the list in 1985 (Canadian Trend Report, October 1985) — support continues to grow for prevention instead of clean-up and for attention to long-term implications (Canadian Trend Report, fall 1984 and summer 1985). For example:

- 86 per cent of Canadians do not believe that environmental laws should be relaxed in order to achieve economic growth. (Decima, summer 1984)
- After being told that these laws could result in increased prices, 83 per cent of Canadians state that protecting the environment is more important than keeping prices down. (Decima, summer 1984)
- Over 90 per cent of Canadians believe that every major economic project should be proven environmentally sound before it can go ahead. (Centre de recherche sur l'opinion publique, June 1985)

Polls also indicate that Canadians believe responsibility for preventing pollution is shared fairly evenly among industry, government and individuals (Decima, summer 1985). But they do not believe those responsibilities are being met. For example:

- Two-thirds of Canadians consider Canada's efforts to deal with acid rain to be inadequate. (Decima, summer 1985)
- Only 18 per cent believe that most companies are doing enough to inform their employees and the public of the names and potential hazards of toxic substances they use or produce. (Decima, summer 1985)

CHOICES

Why is it that knowledge of how to use the environment productively and without causing long-term deterioration is increasing but that we are far from putting all this knowledge to use? The most likely explanation is that the problem of maintaining environmental quality is as much political as it is technical or economic — and political problems by definition involve many people with a variety of interests.

The first **State of the Environment Report for Canada** has provided some quantitative information and identified some trends. Environmental reporting will continue and will improve in the future. However, maintaining and improving environmental quality must go beyond assessment and reporting. It must include sound management of the human activities that affect the environment — and this depends upon continued progress on both the political and the scientific front.

Indeed, a political stress-response relationship parallels the natural one: the people of Canada, by their actions and their votes, determine the level of stress on the decision-making process, and it is up to decision-makers in the public and private sectors to respond. The appropriate decision-maker, however, is not always someone else. Each of us — as individuals, as consumers, as members of the community — is also contributing to stress on the environment, and each of us can respond in ways that will reduce or modify that stress. Ultimately, Canadians will have the environment they deserve.

PHYSICAL CHARACTERISTICS OF TERRESTRIAL ECOZONES OF CANADA

TUNDRA CORDILLERA	Long chains of rugged mountains; extensive areas of frozen ground; arctic and alpine tundra* vegetation and some boreal** forest.
BOREAL CORDILLERA	Mountain ranges and valleys; scattered areas of frozen grounds; boreal forest vegetation.
PACIFIC MARITIME	Coastal mountains and fjords; glaciers and icecaps on higher terrain; rain forest vegetation; maritime climate; foresty and fisheries important; urban centres.
MONTANE CORDILLERA	Mountains, interspersed with valleys and plains; complex vegetation and soil types; fruitlands, ranching, forestry are significant activities.
BOREAL PLAIN	Interior plains; boreal vegetation; forestry and hardier cereal grain-growing area.
TAIGA PLAIN	Interior plains; widespread wetlands; tundra and some boreal vegetation; ground usually frozen.
PRAIRIE	Former natural grassland; cereal grain and ranching in heart of continent; large urban centres.
TAIGA SHIELD	Broad plains with sparse vegetation and open woodlands; intermittent areas of frozen ground; important caribou wintering area.
BOREAL SHIELD	Extensive interior plains and hills; boreal vegetation cover; important forestry area.
HUDSON BAY PLAIN	Vast coastal plain; largely tundra cover; ground mostly waterlogged and frozen.
MIXED-WOOD PLAIN	Central agricultural and urban area for eastern Canada; broad plains; deciduous vegetation on uncleared land.
ATLANTIC MARITIME	Mostly hills, some coastal plains; mixed eastern deciduous/coniferous forest; important eastern agricultural and fishing area; urban centres.
SOUTHERN ARCTIC	Broad plains; frozen ground; low shrub tundra and mixed herb-lichen vegetation; important summer and calving area for barren ground caribou.
NORTHERN ARCTIC	Extensive plains and hills dispersed in an arctic archipelago; lichen-herb tundra arctic vegetation; important arctic marine fauna area.
ARCTIC CORDILLERA	Glacier and snow-capped mountain ridges; fjord-indented coast.

* Tundra – Areas of mainly frozen ground north of the tree line with low vegetation and lichens.

** Boreal – Northern areas characterized by thick coniferous and birch/aspen forests mixed with swampy areas.

SOURCE: Environment Canada, Lands Directorate.

SOCIO-ECONOMIC CHARACTERISTICS OF TERRESTRIAL ECOZONES OF CANADA (1981)

	Population		Land Base				Income per Capita
	% of Canada	% Urban within ecozone	Land Area % of Canada	% Stocked Productive Forest within ecozone*	% Farm Land within ecozone	% Parks within ecozone	Index Canadian average = 100
TUNDRA CORDILLERA	0.1	0	3.8	7	–	1	120
BOREAL CORDILLERA	0.1	57	4.3	19	–	9	120
PACIFIC MARITIME	8.3	85	2.0	25	1	15	119
MONTANE CORDILLERA	2.9	58	4.6	56	3	5	102
BOREAL PLAIN	2.5	41	8.9	29	12	2	86
TAIGA PLAIN	0.2	46	5.6	19	–	8	78
PRAIRIE	14.7	77	4.9	1	87	< 1/2	107
TAIGA SHIELD	0.2	69	13.0	6	–	–	102
BOREAL SHIELD	9.7	60	18.2	50	1	7	81
HUDSON BAY PLAIN	0.1	12	3.7	2	–	7	48
MIXED-WOOD PLAIN	53.1	84	2.0	14	41	1	103
ATLANTIC MARITIME	8.3	50	1.9	54	9	1	76
SOUTHERN ARCTIC	0.2	22	10.0	< 1/2	–	–	59
NORTHERN ARCTIC	0.1	23	14.1	–	–	–	60
ARCTIC CORDILLERA	0.1	0	3.0	–	–	7	38
CANADA	24.3 million	62%	9,970,000 km^2	27	6.8%	1.4%	$8438**

* Land supporting trees that could grow to merchantable size within a reasonable length of time.

** 1980 $

SOURCE: Statistics Canada.

STATE OF THE ENVIRONMENT REPORT FOR CANADA

This is the first comprehensive report on conditions and trends in the Canadian environment. Using information from a wide variety of government and non-government sources, the **State of the Environment Report for Canada** assesses the degree to which human and natural stresses affect the conditions of our farmlands, forests, water and wildlife. Where possible, data are presented in a manner that is environmentally appropriate; for this purpose a set of 15 terrestrial ecozones was developed.

The report examines the sources and effects of contaminants on human health and the environment. It also documents the expansion of federal and provincial park systems and the creation of international biosphere reserves. Finally, it reviews government actions in response to environmental change in terms of legislation and expenditures.

The report contains 280 pages of narrative plus numerous tables, charts and maps and will serve as a valuable tool to individuals in government, industry and universities, as well as consultants.

State of the Environment Report for Canada, Catalogue No. EN 21-54/1986E or (for French) Catalogue No. EN 21-54/1986F, is available for $25.00 from The Canadian Government Publishing Centre, Supply and Services Canada, Ottawa, Ontario K1A 0S9. (613) 997-2560.

HUMAN ACTIVITY AND THE ENVIRONMENT:

A STATISTICAL COMPENDIUM

Statistics Canada's new 375-page publication, **Human Activity and the Environment: A Statistical Compendium,** is a comprehensive statistical description of the state of Canada's environment with special emphasis on the variety and intensity of human ventures that affect Canada's environment. This compendium of environmental, social and economic data has been compiled from a variety of sources, including Statistics Canada, Environment Canada and federal and provincial government agencies. It documents everything from population distribution to mining and from industrial emissions to contaminants in fish.

The Compendium is a statistical reference for scientific researchers, policy-makers, consultants, students and the general public. It contains 172 tables, 66 charts and 77 maps, many in colour. Data are presented for drainage basins and ecological regions as well as provinces.

Human Activity and the Environment: A Statistical Compendium, Catalogue No. 11-509E or (for French) Catalogue No. 11-509F is available for $45.00 in Canada ($55 in other countries) from Publication Sales and Services, Statistics Canada, Ottawa, Ontario K1A 0T6. (613) 993-7276.

Additional copies of **Canada's Environment: An Overview** can be requested from Environment Canada, Ottawa, Ontario K1A 0H3.

This project was managed by Peter J. O'Hara with the assistance of Darrell Piekarz. The text for this publication was prepared by Marbek Resource Consultants Ltd.; graphics were prepared by Aerographics.